UNCLASSIFIED

OPERATION and MAINTENANCE MANUAL

FOR

REFRIGERATOR- MECHANICAL

BIOLOGICAL

5.4 CU.FT. BLOOD BANK

NSN: 4110-01-358-3836

115V/50-60HZ/1PH or 220V/50-60HZ/1PH

MODEL ERB-5-0378

MGR EQUIPMENT CORP.
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INWOOD, NY 11696

UNCLASSIFIED

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SAFETY SUMMARY

The following are general safety precautions that personnel must understand and apply during operation and maintenance to ensure personnel safety and health and the protection of government property. Portions of this information may be included in certain chapters of this publication for emphasis.

KEEP AWAY FROM LIVE CIRCUITS

Operating and maintenance personnel must at all times observe safety regulations. Do not replace components or make adjustments on the unit with the voltage supply turned on.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt service or adjustment unless another person capable of rendering aid and resuscitation is present.

RESUSCITATION

Personnel working with or near dangerous voltages shall be familiar with modern methods of resuscitation . Such information may be obtained from the Director of Base Medical Services.

GIVE CLEANERS/CHEMICALS SPECIAL CARE

Keep in approved safety containers and in minimum quantities. Some cleaners/chemicals may have an affect on skin, eyes and respiratory tract. Observe manufactures WARNING labels and safety directives. Use only in authorized areas. Discard soiled cleaning cloths into safety can.

COMPRESSED AIR

Use of compressed air can create an environment of propelled foreign particles. Air pressure shall be reduced to less than 30 p.s.i. and used with effective chip guarding and personal protective equipment.

DANGEROUS PRESSURES

Pressure systems safety precautions apply to all ranges of pressure. Care must be taken during testing to ensure that all test connections are properly and tightly made prior to applying pressure to the test setup.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Wear protective clothing/equipment (gloves, apron, eye protection, etc.) approved for the materials and tools being used.

WARNING

Disconnect power from refrigeration unit before performing any maintenance on electrical components. The voltage used may be lethal.

WARNING

Work in a well-ventilated area. **DANGEROUS CHEMICAL** is used in this equipment **DEATH** or serious injury may result if personnel fail to observe proper precautions. Great care must be exercised to prevent contact of liquid refrigerant gas discharged under pressure with any part of the body. The extremely low temperature resulting from rapid expansion of liquid refrigerant or refrigerant gas released under pressure can cause sudden and irreversible tissue damage through freezing. As a minimum, all personnel must wear thermal protective gloves and a face shield or goggles when working in any situation where refrigerant contact with the skin or eyes is possible. Application of excessive heat to any component in a charged system will cause extreme pressure that may result in a rupture, possibly explosive in nature.

WARNING

Refrigerant under pressure is used in the operation of this equipment. Death or severe injury may result if you fail to observe safety precautions. Do not let liquid refrigerant touch you, and do not inhale refrigerant gas.

WARNING

Discharge refrigerant in an open and approved area and not around an open flame.

WARNING

All Refrigerant-12 must be discharged from the system and that section of the system being repaired must be purged with dry nitrogen before beginning any debrazing operation. When R-12 comes in contact with flames, phosgene gas is formed. This is a deadly poison. be sure of sufficient fresh air and ventilation when brazing, soldering or using a halide torch.

WARNING

Nitrogen is an inert gas. However, it also presents a danger as a suffocant and therefore must be discharged in a well-ventilated and approved location.

WARNING

Be sure the refrigeration system is pumped down or fully discharged and that dry nitrogen is flowing through the section of the system that you are brazing at a rate of 1-2 cfm before brazing or debrazing.

WARNING

Wear welder's gloves or other thermal protective gloves while performing any debrazing or brazing procedures.

WARNING

Dry cleaning solvent (Fed. Spec. P-D-680, Type II) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of dry cleaning solvent is 100°F to 138°F (38°C to 59°C).

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CHAPTER 1. GENERAL INFORMATION

SECTION 1. INTRODUCTION

This 5.4 cu. ft. stainless steel refrigerator is designed for the storage of either laboratory reagents or human blood, at a constant preset temperature of from 2°C (35.6°F) to 4°C (39.2°F).

Dual temperature controls in case one fails, automatic off-cycle defrost and condensate evaporator are standard features.

Two stainless steel drawers, on nylon rollers, are provided for the storage of 45 bottles (500 ml) or 60 blood bags (450 ml) with drawer adapter racks inserted.

A temperature monitoring system gives audible and visual warnings of dangerous temperatures or power failure. A rechargeable Ni-Cad battery is incorporated into the system in case of normal A.C. power failure.

A remote mounted eight inch, 7 day, spring wound temperature recorder is supplied as standard equipment with each biological refrigerator.

To obtain the maximum use and satisfaction from its many outstanding features, This biological refrigerator should be installed and operated properly. See Chapters 2 and 3 for installation and operating instructions.

Physical Data:	Height	36.00"
	Width	24.00"
	Depth	24.00" (without door)
	Approx. Weight	350 lbs.

Electrical Data: 115V/50-60HZ/1PH or 220V/50-60HZ/1PH (A.C.)

STORAGE DATA: Unit to be stored in a dry controlled atmosphere.

WARRANTY INFORMATION: This unit is guaranteed for 18 months from date of acceptance, with a five year warranty on the compressor.

TOOLS/TEST EQUIPMENT: A standard set of refrigeration tools is recommended for maintenance on this unit. No special test equipment is required.

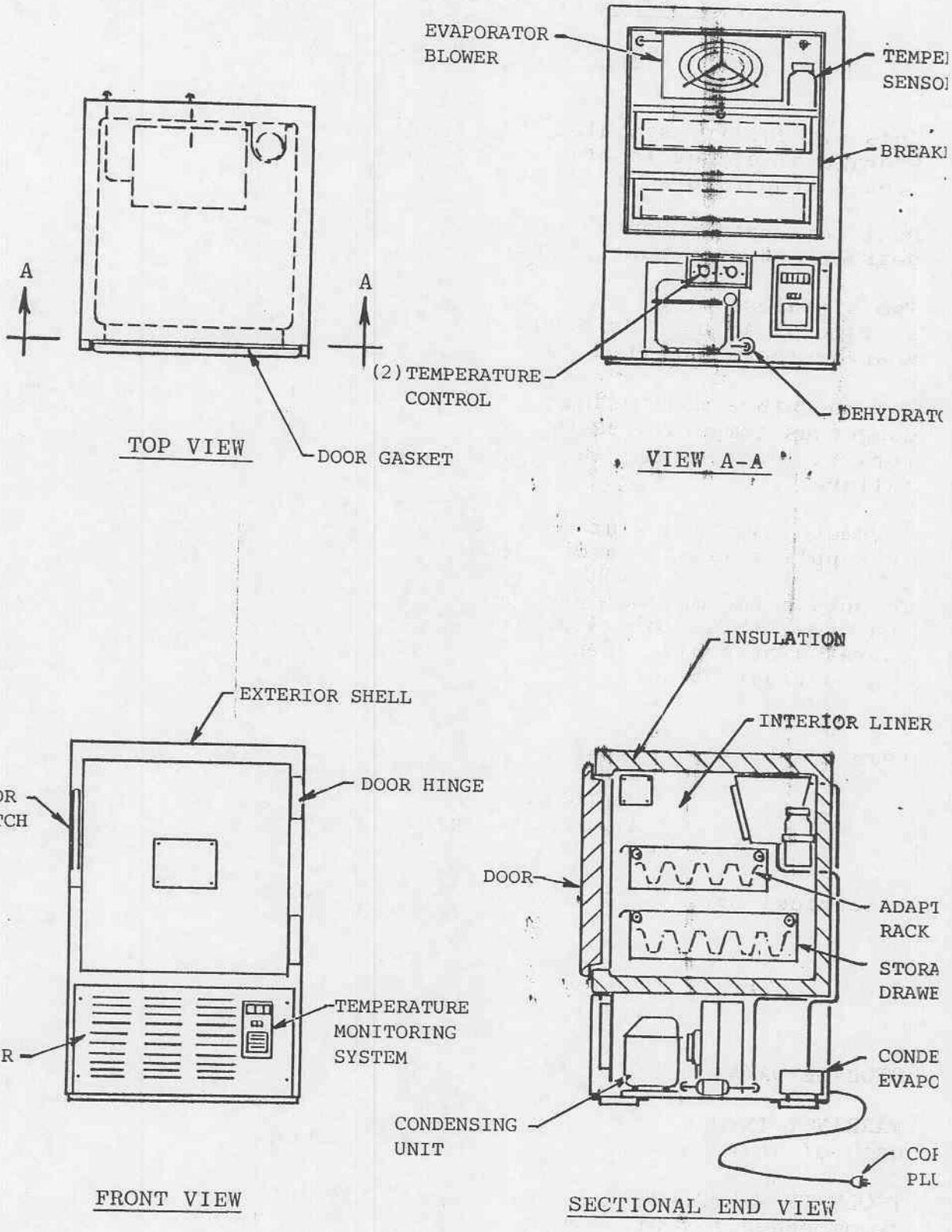

Figure 1-1 - Biological Refrigerator

SECTION 2. DETAILED DESCRIPTION OF COMPONENT PARTS

1-1 EXTERIOR SHELL

The front, top and sides of the exterior shell is constructed of 20 gauge stainless steel, series 302, 18-8, #4 polished finish. The back and bottom are fabricated from 20 gauge galvanized steel. The exterior shell is assembled by means of spotwelding on all the flanges with additional supporting seam welding. Before assembly, an odorless sealing compound is inserted between the flanges. When the shell is welded together this compound is compressed between the flanges to form a vapor proof seal. The only removable panel on the exterior shell is the front louver. The front louver is fastened to the exterior shell by machine screws in each corner.

1-2 INTERIOR LINER

The interior liner is constructed of 20 gauge stainless steel, series 302, 18-8, #4 polished finish. The interior liner is assembled in the same manner as the exterior shell. To further insure a good vapor proof seal and also close all dirt crevices, all seams horizontal and vertical of the interior liner are sealed after assembly. All horizontal and vertical corners of the inner liner are coved with a 1/4" radius to enable easy cleaning.

1-3 DOOR

The door is of the infitting type and is fitted with a plastic gasket that is replaceable. Door exterior and interior is made of the same material as the interior liner of the refrigerator. The door has an internal welded frame with hinge and latch tapping plates welded thereto. The hardware is attached to the door by machine screws which are inserted into machine tapped holes through the shell and frame.

1-4 DRAWERS AND ADAPTER RACKS

Mounted on nylon rollers, inside the refrigerator, are two stainless steel drawers provided for the storage of bottles. Also provided, as drawer inserts, are two stainless steel adapter racks for the storage of blood bags. Both drawers and adapter racks are easily removable for cleaning.

1-5 INSULATION

The insulation used in the cabinet is a high density foam-in-place polyurethane that is not combustible nor will it support combustion and will not release toxic fumes when exposed to high temperatures. The complete insulation spaces of the cabinet and door are filled as to leave no voids. The insulation is also provided with a vapor barrier and designed to prevent accumulation of moisture and possible saturation.

1-6 BREAKER STRIP

The breaker strips are of 1/8" thick odorless panelyte. The breaker strips are installed with self threading stainless steel screws with machine type screw threads. A coating of odorless asphalt mastic is applied to the shell flanges before the breaker strips are installed. The breaker strips are removable.

1-7 DOOR GASKET

The gasket is a molded plastic type gasket and is installed to provide a close fitting type seal. The gasket is replaceable and can be removed by removing the screws which hold it in place. The gasket is of the odorless type and can be cleaned with soap and water only.

1-8 DOOR HARDWARE

Both the door latch and door hinges are of the one piece construction and made of forged brass. The door is perfectly aligned at the factory before shipment. Due to moving in transit, the door may require adjustment when installation is made. If adjustment is necessary, follow these simple instructions:

A. There is no adjustment on the door latch or door hinge; the only adjustment is on the strike of the latch.

B. If door does not close tightly, loosen the screw on the strike, push strike inward and tighten the screw.

C. If door closes to tightly, loosen the screw on the strike, pull strike outward and tighten the screw.

1-9 TEMPERATURE SENSOR BOTTLE

Located on the inside of the cabinet, to the right of the blower is a plastic bottle. This bottle when filled with glycerine acts as a wet bulb temperature sensor.

1-10 CONDENSATE EVAPORATOR

A condensate evaporator is provided in the rear of the machinery compartment to assist in the evaporation of water. Water accumulated from the evaporator, during the automatic off cycle defrost, drains into the condensate evaporator where it is evaporated off into the atmosphere.

1-11 CAPILLARY TUBE ASSEMBLY

The capillary tube acts as the liquid line and metering device. The capillary tube meters the refrigerant into the evaporator, This line originates from the condensing unit and extends into the evaporator.

The capillary line is constructed of seamless copper tubing and is soldered to the suction line for approximately eighteen inches; this acts as a heat interchanger. The heat interchanger pre-cools the refrigerant going up to the evaporator and warms the refrigerant going back down to the compressor so, therefore, serves a dual purpose. The capillary length and bore are adjusted so that it will pass the required amount of liquid under the normal differences of pressure in the system.

1-12 DEHYDRATOR

The dehydrator is placed directly before the liquid strainer and the purpose served is to keep moisture out of the refrigerant circuit. The dehydrator is flare connected to enable easy replacement.

The dehydrator is 7 cu. in. and contains silica-gel which is a moisture absorbing chemical. If the refrigerant lines are disconnected for servicing, the dehydrator MUST be replaced as silica-gel, when exposed, absorbs a maximum amount of moisture.

1-13 EVAPORATOR BLOWER

The evaporator is of the forced circulation type. The evaporator is constructed of 3/8 O.D. seamless copper tubing formed in a continuous serpentine coil. Conduction fins are mechanically bonded to the coil and are spaced on 1/4" centers over the complete surface of the coil. After fabrication, the coil and the fins are electro-tin plated.

The coil is installed so that the finned surface is facing the rear of the refrigerator. A stainless steel louvered housing is fastened over the front surface of the coil. The coil is installed in this manner so that the suction fan is constantly pulling the warmer air over the coil and re-circulating the air in an undisturbed cycle.

The fan motor, 1/20 HP, 115 V., is attached to the aluminum hub with machine screws and the hub is attached to the exterior casing. For removal or replacement of either the fan or motor, it is only necessary to remove louvered shield and then remove the machine screws holding the motor in place.

The complete evaporator is attached to the ceiling with hexagon head bolts, washers and nuts. Three bolts are welded to the overhead structural bracket. There are a total of three (3) 1/4" bolts holding the blower coil.

The exterior bottom of the evaporator acts as a drip pan with a 1/2" O.D. drain line extending from it through the rear wall and down into the condensate evaporator.

While the refrigerator is operating, the blower coil should ne be shut off. The evaporator will defrost automatically on the OFF cycle of the condensing unit.

CAUTION

DO NOT SCRAPE ICE OR FROST OFF THE BLOWER COIL, AS THIS WILL CAUSE DAMAGE TO THE COIL

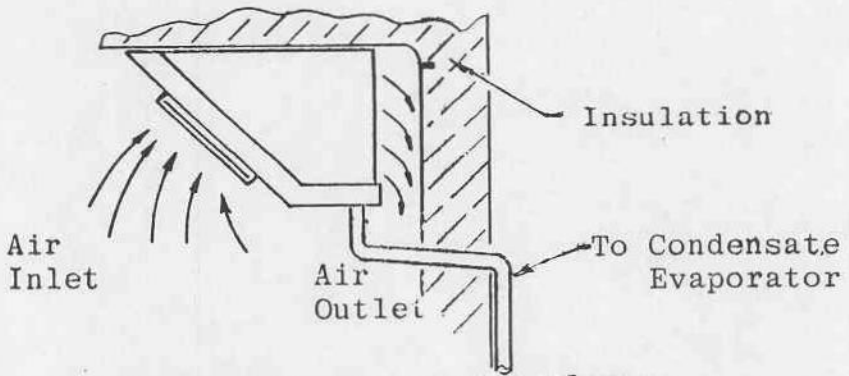

Figure 1-2 Evaporator Blower

1-14 TEMPERATURE CONTROL

The automatic operation of the refrigeration machinery is controlled by means of a temperature control located on the inside of the folding evaporator door on the inside of the refrigerator. The temperature control is fitted with a two foot long capillary which is mounted in the cabinet to sense the temperature. The capillary line contains a liquid charge that expands and contracts as the temperature in the cabinet goes up or down. This expansion or contraction turns the switch "ON" or "OFF".

The temperature control is a S.P.S.T. snap acting toggle switch that automatically cycles to CLOSE the circuit on rise and OPEN the circuit on drop in temperature. The control has a dial knob adjustment for any slight variation in compartment temperature that may be required. The dial is factory set to provide a compartment temperature of 3°C . To lower the temperature, turn the knob clockwise to a lower setting. At no time except for servicing or replacement purposes should the knob be removed.

The temperature at which the switch opens and closes the circuit is adjustable within the limits of the operating range of the temperature control. A differential adjusting screw is also provided on the control to vary the point at which the circuit opens. This adjustment is quite critical and is factory set. DO NOT adjust more than 3/8 turn in either direction. A clockwise rotation of the differential screw will decrease the differential 3; whereas a counterclockwise rotation will increase the differential 3 at the maximum. The range adjustment always sets the point at which the circuit opens and is governed by the differential adjustment.

A change in the setting of the range adjustment raises or lowers both the opening and closing points, and the differential does not remain constant over the whole operating range but varies with a change in the range adjustment setting.

The range adjustment knob and the differential adjustment screw are both located on the case of the temperature control and do not require it to be opened. Both of these adjustments are factory set when the refrigerator is tested prior to shipment.

NOTE:

On this biological refrigerator a secondary Temperature Control is provided in case of failure to the primary Temperature Control.

1-15 CONDENSING UNIT

The condensing unit is a model AE9419EG as manufactured by the Tecumseh Products Company. The condensing unit is of the hermatic type with the compressor and motor sealed in a welded dome. The pistons are partially submerged in oil, therefore, no parts of this unit require lubrication. A forced air cooled condenser constructed of finned tubes is provided for cooling of the refrigerant.

The condensing unit also contains a relay and overload protector which are described on the following page.

Compressor Data

Bore - 1 3/32"
Stroke - 5/8"
No. of Cylinders - 1
Displacement - .588

Motor Data

Nominal H.P. - 1/4
Type - Capacitor Start
Volts - 115
Hertz - 50 - 60

Refrigerant - Freon R-22

Oil

Type - Suniso #3G
Charge - 10 oz.

Connections

Suction - 3/8" SAE
Liquid - 3/8" SAE
Gage - 1/4" SAE

Dimensions

Length - 12-3/4"
Width - 12"
Height - 9-7/8"
Weight - 40 lbs.

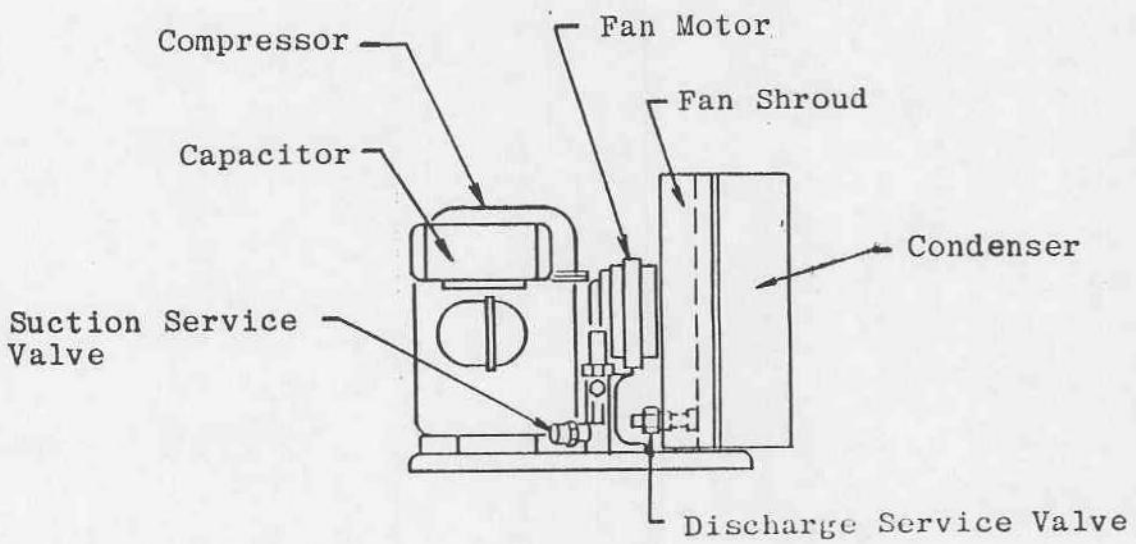

Figure 1-3 Condensing Unit

1-16 RELAY

The relay consists of a magnetic coil which actuates a movable contact and completes the circuit through the starting winding of the motor. When the motor reaches a pre-determined speed, the magnetic coil releases the movable contact and disconnects the starting winding from the circuit. The motor running winding, however, remains in the circuit at all times. The relay is mounted on a shell bracket and no adjustments can be made in the field. In case of relay trouble, the complete assembly can be changed by simply removing the mounting screws and disconnecting the leads.

The fundamental theory back of the split phase motor is that a starting torque is induced by a starting winding and main winding in the motor being more or less out of phase with each other electrically and as soon as speed of the motor is brought up to a certain point, the starting winding is cut out and the full load is carried by the running winding of the motor.

1-17 OVERLOAD PROTECTOR

This device, together with the starting relay, is mounted on a bracket welded to the compressor shell and protected by a stamped steel housing.

The motor protector consists of a small, round, plastic casing containing a heater coil (a) and a bi-metal disc (b). The heater coil is designed to carry normal starting and operating currents. However, should the current increase an abnormal amount for any reason, the excessive heat from the coil causes the bi-metal disc to snap open, thus breaking the electrical circuit and stopping the motor. In case the motor winding temperature increases for any other than electrical reasons, the disc is also affected by shell temperature, thus again, protecting the motor from excessive temperature. The motor protector is, therefore, in reality, an electro-temperature protector because it protects the motor windings from getting above pre-determined and safe temperatures in all cases.

When the overload trips for any reason, the circuit remains open until the shell temperature cools down to the proper point, at which time the bi-metal disc snaps closed, thus again starting the motor. This process is repeated as long as there is an abnormal load condition on the compressor for any reason.

The motor protector is not adjustable and if it fails to function properly, it must be replaced with a factory adjusted assembly.

When a unit is started originally with a warm cabinet, the protector may open and close a few times until the cabinet begins to cool down. This is a normal condition at the time of the start up and should not be interpreted as motor protection trouble.

1-18 TEMPERATURE MONITOR

This state-of-the-art temperature monitor and alarm protects the contents of the biological refrigerator against costly spoilage. Dual set points for critical temperatures above 4°C. (39.2°F.) or below 2°C. (35.6°F.) energize a continuously sounding siren as well as a blinking LED. A pre-set delay prevents the siren from sounding during normal door operation or defrost cycle.

A loss of normal A.C. power energizes the rechargeable battery system to turn off the LED display and energize the siren for a minimum of 12 hours. To energize LED display, during normal A.C. power loss, place monitor button in the test position.

The temperature monitor also has a built in memory to record information during alarm or power-off condition. To report memory place monitor button in the test position and the LED will display the length of time of alarm and highest temperature observed during alarm condition.

Figure 1-4
Temperature Monitor

1-19 TEMPERATURE RECORDER

A, remote mounted, 7 day, spring wound temperature recorder with an operating range of -30° to +70° is supplied with each refrigerator. The recorder is mercury actuated and comes with 5 foot of capillary tubing and a 6" long x 1/2" diameter stainless steel sensing bulb.

A single fiber tip pen and (50) 8" diameter charts are supplied with each recorder.

CHAPTER 2 - INSTALLATION

2-1 INSTALLATION INSTRUCTIONS

A. Uncrate refrigerator cabinet. Inspect the complete exterior and interior of the refrigerator cabinet including the machinery compartment for damage. Be sure that all packing and crating materials have been removed. The cabinet is not bolted to the crate, however it is pressure packed between the bottom skid and the top section of the crate.

B. Move the biological refrigerator into the desired location, making certain that the bottom is evenly supported. The refrigerator cabinet must be set level from front to rear and side to side. Shims under one or more corners may be required to level the cabinet.

CAUTION

IT IS IMPORTANT THAT THE INITIAL INSTALLATION OF THE UNIT BE ACCOMPLISHED IN A PROPER MANNER. ONE VERY IMPORTANT POINT TO REMEMBER IS THAT THE CONDENSING UNIT IS AIR COOLED, THEREFORE, ON INSTALLATION THE REFRIGERATOR SHOULD BE PLACED AT LEAST 2" AWAY FROM THE WALL FOR GOOD CONDENSING UNIT AIR CIRCULATION.

C. Install the refrigerator cabinet so as to provide a minimum clearance of 2" at the rear. This clearance is essential for the proper circulation of air through the static cooled condenser for cooling the condensing unit. Make certain that the front louver on the machinery compartment is unobstructed since this panel must be removed for servicing the refrigeration machinery.

CAUTION

THIS BIOLOGICAL REFRIGERATOR IS SET TO OPERATE ON 115V./50-60HZ./1PH. OR 220V./50-60HZ./1PH. A. C. DO NOT CONNECT TO ANY OTHER SOURCE OF POWER AS PERMANENT DAMAGE MAY RESULT.

D. The power supply for the refrigeration unit should have its own ampere fusing so that power will not inadvertantly be shut off to the unit and thus cause damage to the content.

E. After installation of Refrigerator, mount Temperature Recorder within six (6) feet of refrigerator.

F. Remove and fill Temperature Sensor Bottle and reinstall bulb from Temperature Monitor. Install stainless steel sensing bulb, from Temperature Recorder, through hole supplied in rear of the refrigerator and place the sensing bulb into the sensor bottle.

G. When using 115V/50-60HZ/1PH power supply connect unit power cord directly to power supply.
When using 220V/50-60HZ/1PH power supply connect unit power cord to receptical located on transformer and connect power cord from transformer directly to power supply.

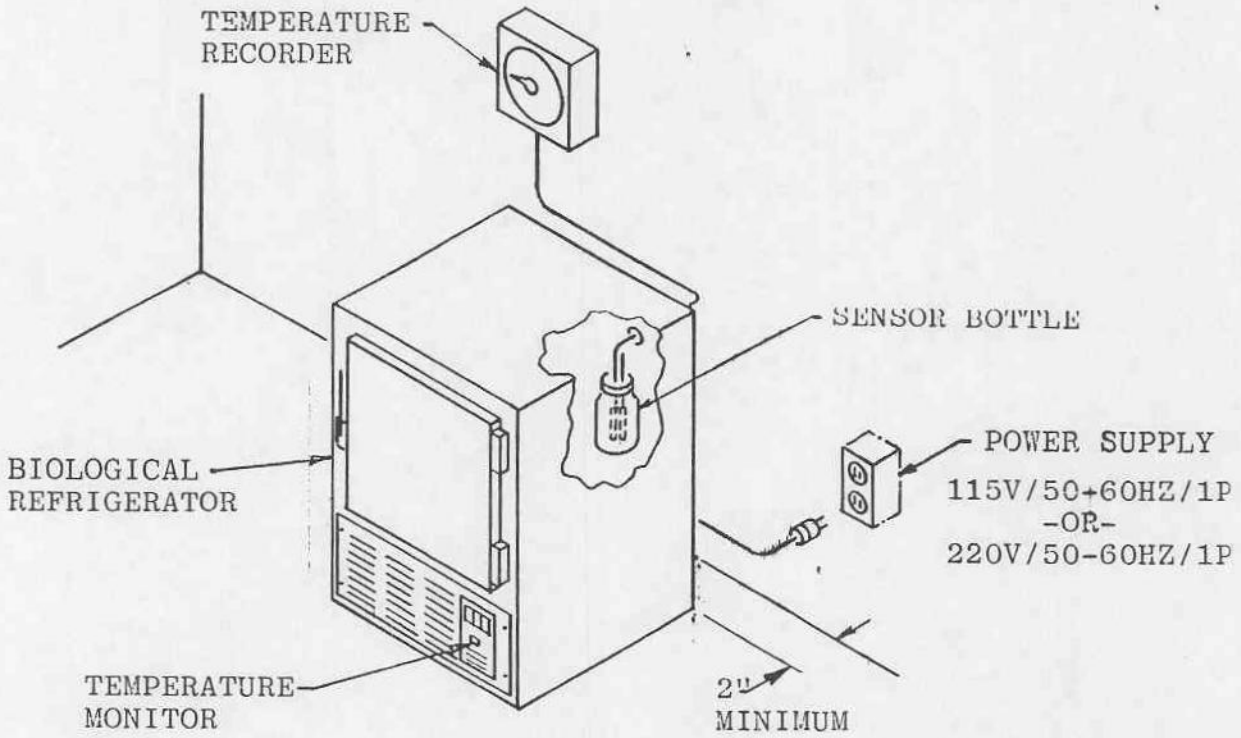

Figure 2-1 Installation

H. It is recommended that before the unit is started for the first time, a competent refrigeration serviceman check the installation for leaks and general operation. The refrigeration system including all piping was checked and tested at the factory for leaks before shipment; it is possible that during shipment some connections might have loosened or some adjustment may be necessary.

I. The biological refrigerator is ready for operation once it is connected to a source of electrical power. The service valves on the condensing unit are open and in the proper operating position. The temperature control is factory set to maintain a constant interior temperature of from 2°C (35.6°F.) to 4°C (39.2°F.). No adjustments should be made unless this temperature is not being maintained in the cabinet. This will take between 2 and 4 hours after the unit is turned on before the correct operating temperature is reached.

J. The door seal should always be tested before a refrigerator is placed in operation. A poor door seal usually results in sweating cabinet surfaces, excessive condensing unit running time and high cabinet temperature. The tightness of the door seal can be tested at the four corners and midpoint of the door by trying to insert a 0.003-inch leaf-gage between the gasket and the seating face. Resistance to this insertion should be noticeable. If not, the door strike must be adjusted in accordance with the instructions given on page 1-4. Before any adjustments of the door strike, be certain that the cabinet is installed level as this will affect the door seal.

2-2 UNIT RESHIPMENT REQUIREMENTS

In the event it becomes necessary to remove the refrigerator cabinet from its installed position and to prepare it for shipment back to the factory, the above procedure should be followed in reverse.

Care should be taken in crating the refrigerator cabinet so that it does not move within the shipping crate. This can be accomplished by either bolting the base frame to the skid or by pressure packing between the bottom skid and the top section of the crate.

CHAPTER 3 - OPERATING INSTRUCTIONS

SECTION 1 - DESCRIPTION OF A REFRIGERATION CYCLE

The maintenance of a constant and correct temperature in a refrigerated compartment is dependent upon the intermittent circulation and evaporation of a fixed supply of refrigerant in the evaporator. By means of a thermostatic control whose heat sensitive element is located on the evaporator, the motor compresser pumps the heat laden gas out of the evaporator through the suction line and into the compressor. The low pressure gas is then compressed by the piston and forced out through the discharge valve into the condenser.

The part of the system from the metering device exit to the discharge valve in the compressor is called the low pressure side. That part of the system extending from the discharge valve through the condenser and up to the metering device exit is called the high pressure side.

As high pressure vapor leaves the compressor and enters the condenser, the higher temperature vapor loses its heat to the air by means of radiating fins which form a part of the condenser. The result is that the high pressure vapor is converted into liquid refrigerant. The liquid refrigerant then passes through a metering device and into the evaporator.

As the liquid refrigerant in the evaporator is subject to a much lower pressure due to the suction of the compressor, it follows that evaporation of the liquid refrigerant will take place at a reduced pressure and temperature with the result that heat is absorbed from the refrigerated compartment. As the pressure and temperature in the evaporator are being lowered by the compressor, a point is reached where the refrigerated chamber has lost sufficient heat to lower the temperature to a point where the control will break the motor circuit and stop the compressor.

The lower suction pressure will soon rise due to the sustained boiling point of the refrigerant.

When the boiling stops, the refrigerant will not absorb heat which results in the rise of the refrigerated chamber temperature. Finally, the point is reached where the thermostatic control in the refrigerated space causes the motor to cut in, starting the compressor and beginning the refrigeration cycle over again.

A refrigeration diagram is shown in figure 3-1 on page 3-2 a wiring diagram is shown in figure 3-2 on page 3-3.

NOTE: Normal refrigerant pressures for the freezer and refrigerator discharge is approximately 130 lbs. When the ambient temperature is at 90°F., suction pressure for refrigerator is approximately 19 lbs. (35°F.), freezer approximately 2 lbs. (0°F.).

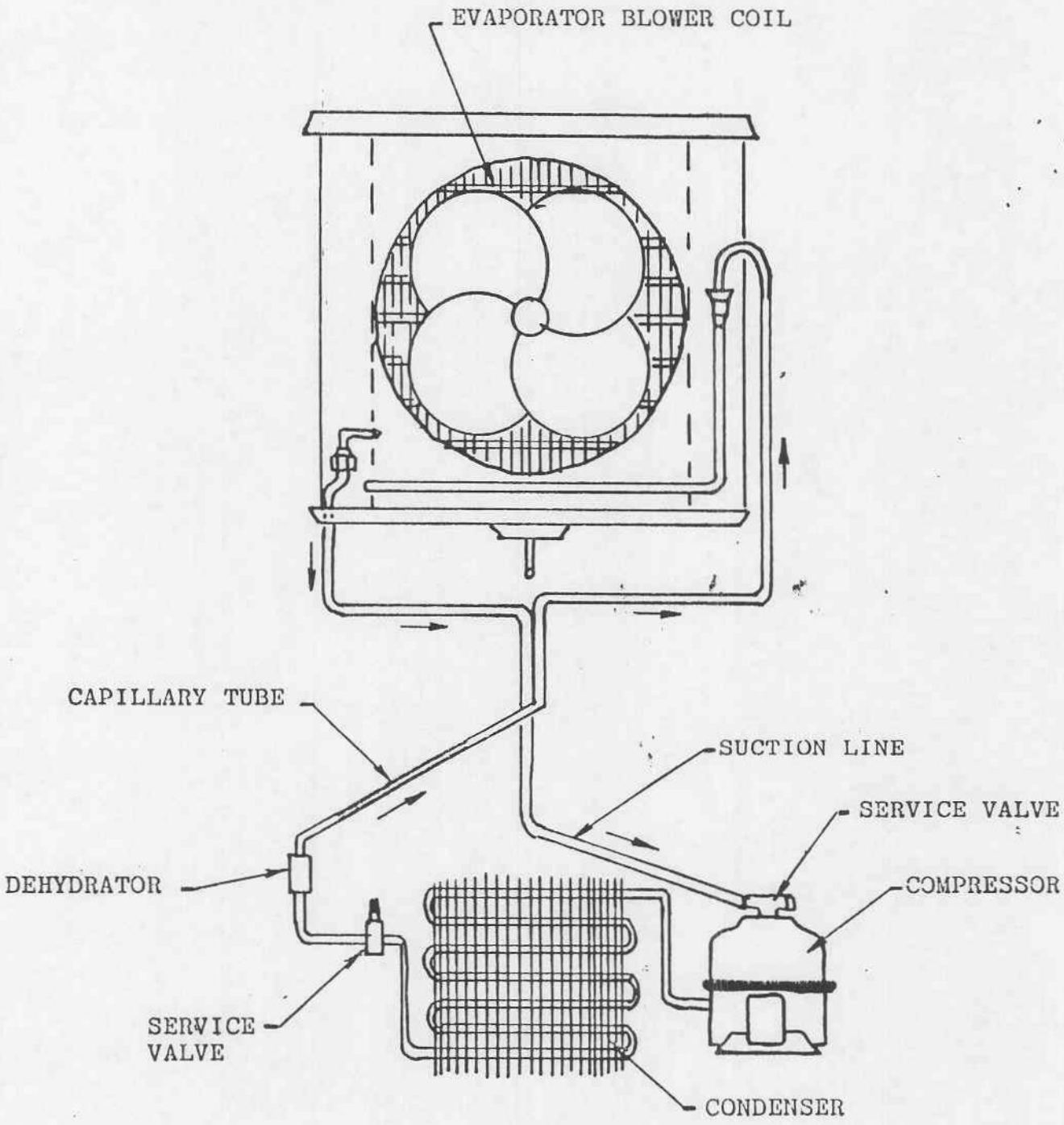

Figure 3-1 Refrigeration Diagram

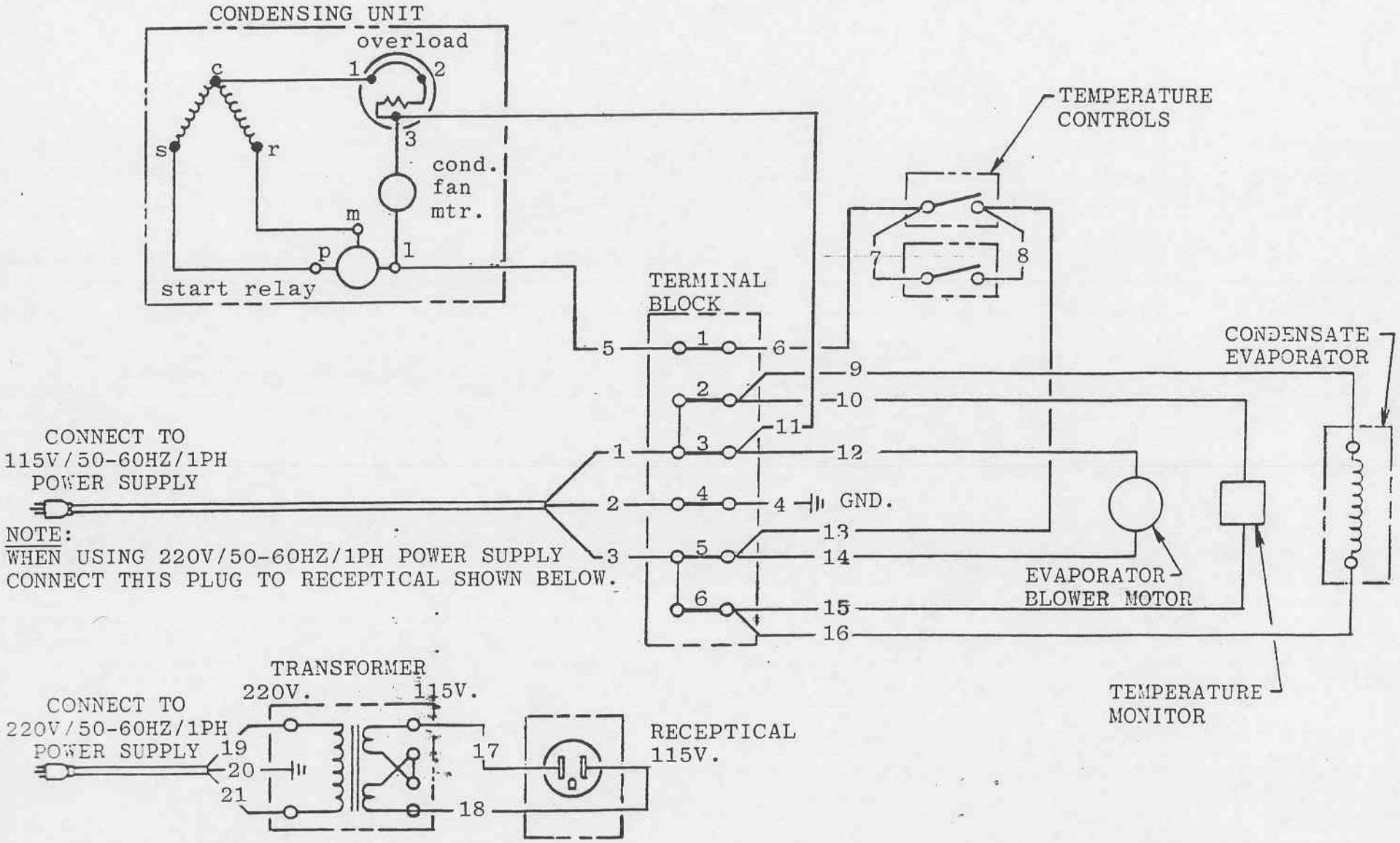

Figure 3-2 Wiring Diagram

SECTION 2 - OPERATING TIPS

3-1 LOADING THE BIOLOGICAL REFRIGERATOR

A. Before loading the biological refrigerator, be sure the interio temperature has reached between 2°C (35.6°F) and 4°C (39.2°F). As stated previously, it will take anywhere from 2 to 4 hours to reach this temperature after the unit is started for the first time. During this period of time the condensing unit will be running continuously. The acutal interior temperature can be checked with the temperature monitor located on the right side of the machinery compartment.

B. Do not attempt to chill too much product at one time. Loading the drawers with an excessive amount of warm product will only rais the cabinet temperature excessively. Loading and unloading of the drawers should be kept to a minimum since this will also tend to increase cabinet temperature.

SECTION 3 - OPERATOR'S MAINTENANCE

3-2 CONDENSING UNIT

The finned condenser at the rear of the machinery compartment must be kept clean. If excessive dirt is allowed to accumulate on the coil, the condenser will not receive proper air circulation. It is important that the condenser coil be cleaned at least once every 60 to 90 days. It is also advisable to shut off power to the refrigerator cabinet when cleaning the condenser coil.

3-3 CLEANING THE CABINET

In cleaning the interior of the refrigerator, use a solution of baking soda or borax and hot water. These compounds act as deodorants and will not scratch or mar the finish. A suitable soda soluti consists of 1/2 teaspoon of ordinary baking soda to a quart of water

The exterior of the cabinet may be cleaned in the same manner a windows are cleaned; that is with clear water, a weak baking soda solution, or with Bon Ami.

Door gaskets will remain in the best condition if washed once a month with mild soap and water followed by a fresh rinse. Grease an dirt accumulation on door gaskets will shorten their life considerab

CHAPTER 4 - MAINTENANCE AND REPAIR

SECTION 1 - SAFETY PRECAUTIONS

WARNING

REFRIGERANT UNDER PRESSURE is used in the operation of this equipment. DEATH OR SEVERE INJURY may result if you fail to observe safety precautions. Never use a heating torch on any part that contains refrigerant. Do not let liquid refrigerant touch you and do not inhale refrigerant gases.

WARNING

Disconnect power from refrigerator before doing any maintenance work on the electrical system. The voltage used can be dangerous to life.

4-1 SAFETY PRECAUTIONS

A. In testing for leaks in tubing circuits, use carbon dioxide or nitrogen. Never use oxygen. It may cause an explosion.

B. Silver brazing materials sometimes contain cadmium. Fumes from cadmium are very poisonous. Be sure that the work space is well ventilated. If at all possible, use silver brazing alloys which DO NOT contain cadmium.

C. It is recommended that refrigerant cylinders never be filled above 85 percent of their capacity. If over-filled, the hydrostatic pressure may cause them to burst.

D. Wrenches used on refrigeration line fittings should always fit the nuts well. Poorly fitting wrenches will ruin nuts and bolt heads.

E. Always "crack" service valves and cylinder valves before opening. This gives positive control of the flow of gases.

F. Tubing should be bent in as large a radius as possible.

G. Moisture is always a hazard to the refrigerating mechanisms. Keep everything connected with refrigerating mechanisms thoroughly dry.

H. Emery cloth should not be used to clean tubing preparatory to soldering. It may leave an oily deposit on the tubing. The grit is hard and would cause considerable damage if it enters the system.

REFRIGERANT - THE REFRIGERANT USED IS R-12

4-2 LOW REFRIGERANT IN THE SYSTEM

Should a compressor operate too long a period or too often, it is generally due to the refrigerant supply being low even though the cabinet temperature is cold enough.

When the refrigerant is a little low, the head pressure may be below normal with the machine running; when the supply is very low, the pressure may drop considerably within 10 or 15 minutes after the compressor stops. The suction or back pressure may be higher than normal while the machine is idle and drops more quickly than it should when the compressor starts and may continue to be lower than normal with the apparatus in operation.

In case of low refrigerant, first locate the cause which is almost certain to be a leak (see paragraph 4-6 - Testing for Leaks). Do not add any refrigerant until leak has been found and repaired.

4-3 HOW TO ADD REFRIGERANT

Weigh the service cylinder before and after adding refrigerant as this is the only way to determine how much refrigerant has been added.

Be sure the low side suction valve is turned all the way to the left to close the gage port. Install a compound gage hose on one end and connect the center hose from the manifold to the refrigerant cylinder. Before tightening the connection finally, crack the service valve to purge air in the regular way. Attach the pressure gage to the highside valve.

Warm the refrigerant service cylinder by putting it into a pail of warm water or by using hot cloths. Do not use a blow torch. Place the cylinder in an upright position with the valve at the top to admit refrigerant vapor and not liquid to the compressor crankcase. Now turn the lowside valve inward so that the compressor crankcase is opened to the compound gage and to the hose which leads to the cylinder for fresh refrigerant. Start the compressor, watch the compound gage, then open the valve on the service cylinder. A competent serviceman should add the proper amount of refrigerant to the corresponding temperature and pressure of the system.

WARNING

Never open a system on a vacuum as air will rush into replace the vacuum and will probably draw some moisture into the system.

4-4 HOW TO PUMP REFRIGERANT BACK INTO THE RECEIVER

When it is necessary to open the system or remove any parts for repairs, all refrigerant must be pumped back into the receiver and condenser if it is to be used again after the repairs are complete. The receiver and the condenser will hold the entire charge of rerigerant.

Attach a compound gage to the lowside or suction valve and a pressure gage to the highside or discharge shut-off valve, purging the connections in the usual way. After the gages are attached, turn both valves back one turn for reading; now close the receiver valve to shut off the receiver from the liquid line going to the expansion valve or capillary tube.

Then start the compressor and run it until the compound gage shows approximately 5 lbs. This operation pulls the refrigerant all the way through the system in the direction of the arrows shown on the refrigeration diagram and forces it into the condenser and receiver. When the 5 lb. pressure is reached, it is almost certain that all refrigerant is pumped back into the condenser and receiver. At this point the unit can be stopped and the highside shut-off valve closed to prevent any refrigerant vapor going back into the compressor should the compressor valves leak.

With refrigerant back into the condenser and receiver, any part can be removed from the unit with the exception of the highside shut-off valve, the condenser and the receiver. These parts will still have refrigerant in them.

4-5 HOW TO DISCHARGE EXCESS REFRIGERANT

Note: Refrigerant should be reclaimed if possible.

Either too much or too little refrigerant will result in improper operation.

A system with too much refrigerant is similar to that with air in system, the head pressure being too high.

This excess liquid floods the condenser and tends to overload the unit possibly causing the overload to trip. The condenser will be hotter than normal near its top and quite cool near the bottom. Refrigeration in the system will not be satisfactory. The refrigerant charge must be reduced to the correct amount by discharging the excess charge. This may be done through the discharge service valve gage port. Install service charging line to a refrigerant service drum. Excess charge may be bled off through center charging hose and the amount of pressure drop can be observed on pressure gage on manifold. Do not discharge large amounts at a time or an undercharge could result.

4-6 TESTING FOR LEAKS

If a leak is suspected in the system, it will be necessary to check the entire system. This means all tubing connections, valves, receiver, condenser, evaporator and compressor. Sometimes oil may be visible where leaks occur.

The method of testing for leaks is two-fold depending on whether or not the leak occurs on the highside or on the lowside.

The lowside refers to that part of the refrigeration system consisting of evaporator, suction line and crankcase up to the intake valve located in the valve plate.

The highside refers to that part of the system extending from the cylinder head, condenser, receiver tank and liquid line up to the evaporator inlet.

It is evident that before testing for leaks on the lowside, it is necessary to build up pressure on that side. This is done by attaching the pressure gage at the suction service valve and charging the system to about 30 psi.

4-7 HALIDE TORCH LEAK TEST

A halide torch is used to detect a leak on the freon 12 refrigerant. A change of color in the flame from blue to green indicates a leak around the joint being tested.

4-8 AIR IN THE REFRIGERATION SYSTEM

Air in the system may be caused by one of two reasons:

1. By careless inservicing or charging methods permitting air to enter the system.
2. By a leak in the lowside when all refrigerant leaks out allowing air to be drawn into the system when operating under a vacuum.

Air is non-condensable under the temperature and pressure conditions existing in refrigerating compressors. Therefore, the air becomes an inert substance which remains in the compressor head and condenser resulting in increased discharge pressures and reduced condenser efficiency. When an excess amount of air is present, the discharge pressure will be excessively high overloading compressor motor, causing overload protector to trip out.

To distinguish whether air in system or an overcharge of the refrigerant is causing the trouble, it will be relatively easy to determine this by shutting off the unit and allowing it to cool to room temperature. In case of refrigerant overcharge, the discharge pressure will return to the normal figure which corresponds to the pressure that is normal for the existing room temperature. However, if air is present, it will be seen that the head pressure does not return to the normal figure when the unit has cooled down to the existing room temperature.

4-9 PURGING AIR

An excess of refrigerant or presence of air in the system will require a purging operation. This operation is done as follows:

> "Allow unit to stand for 15 minutes and purge off air in same manner as purging excess refrigerant charge."

4-10 TESTING THE HERMETIC MOTOR-COMPRESSOR

Many refrigeration troubles are due to motor-compressor failure. In most cases of refrigeration failure it is advisable to check the electrical system first to determine if any of the electrical components, i.e. relay, overload or capacitor are defective. Electrical system check does not indicate any defective components, then proceed to check the motor-compressor.

If for any reason the motor-compressor is not pumping sufficient gas, it is obvious that poor performance will result. This condition will most probably be caused by leaky valves. To determine whether the valves are leaking, test as follows:

> Install a compound gage at the suction service valve on the motor-compressor. Shut off the suction line after having started the compressor. A hammering sound coming from the cylinder head indicates that an excessive amount of oil is being pumped through the compressor. Oil is incompressible and its presence in the cylinder and passing through valves causes the hammering. The valves are designed to stand this abuse. It nevertheless is undesirable because the oil is gradually being transferred to the condenser, which means that insufficient oil remains in the crankcase to lubricate the compressor. As soon as the compressor starts to pump oil, the motor should be shut off for a short period of time and then re-started and stopped until quiet operation of the compressor is secured.
>
> All during this time the compound gage should be given careful attention and when the compressor pumps a 24 inch to 26 inch vacuum or more, it is operating properly. When a 24 inch to 26 inch vacuum is reached, the motor should be shut off and the compound gage carefully watched. In the event the loss of vacuum is pronounced; that is the back pressure readings advance to a pressure within a short period of time, it is a very good indication of leaky discharge valve.

An intake valve leak is indicated by the inability of the compressor to produce a high vacuum, but vacuum produced is maintained after the compressor is shut off providing the discharge valve is holding.

NOTE: If suction and discharge pressures are about equal with compressor running, it indicates that the motor-compressor is not pumping and that the hermetic unit should be replaced.

4-11 REMOVING THE HERMETIC MOTOR-COMPRESSOR

When removal of the motor compressor is necessary, the procedure is as follows:

Remove the refrigerant as described in paragraph 4-4. Disconnect the unit from power source. LOCK the switch or starter in the open position. Tag the switch to inform others why the switch is locked open. Disconnect the wires from the motor-compressor (label them or use color code). Disconnect lines by unbolting suction service valve connection. Open brazed joint in liquid line by heating or cutting the line. Use tube cutter to avoid getting chips into the system. Remove four (4) hold-down clips at each corner and lift up motor-compressor to clear studs. Do not tilt or oil may be spilled. Plug refrigerant opening to prevent dirt from entering the system. Removing a hermetic motor, repairing the bearings, replacing the windings is a specialty job. Servicing of the hermetic motor-compressor is generally limited to replacing the complete assembly by obtaining a new unit or a rebuilt unit.

4-12 INSTALLING HERMETIC MOTOR-COMPRESSOR

A hermetic motor-compressor is usually furnished without starting relay, capacitors, overload protectors, and other accessories. It has service openings and these openings are plugged or it is provided with short tubing ends brazed in place with the ends of the tubing, crimped and brazed.

Carefully mount the motor-compressor in place. Use all safety precautions (lifting, safety shores, etc.). Install the mounting clips or bolts if provided. If externally spring mounted, the springs and grommets must be in the correct position and the hold-down bolt or nut must be positioned correctly.

Install the electrical devices (overload, starting relay, etc.) and the electrical wires (all connections must be clean and tight). All wires must be in good condition (insulation, wire terminals, etc.)

Install the suction and liquid lines by connecting to the service valve in the case of the suction line and by brazing for the liquid line. When brazed connections are used, flux the outside of the brazed joints on the compressor dome, heat (wear goggles) and remove the stubs. Clean the outside of the liquid line, flux the surface, insert the line in the compressor dome, and silver braze (the area must be well ventilated) the joint. Clean the joint (remove flux)

Install a gage manifold on the suction service valve. Evacuate the system, put some vaporized refrigerant in (enough to build a 15 psig pressure), test for leaks, (repair any, if found) evacuate to 10 to 100 micron range for several hours.

Charge the system. Turn on the power, run, check the temperatures, pressures, electrical characteristics. If any detection is made of non-normal operation, be sure to diagnose and remedy before making final control adjustments.

4-13 CHECKING ELECTRICAL SYSTEM

The complete electrical system on the condensing unit can be checked completely and thoroughly with an ordinary test lamp. With the unit plugged in, refer to wiring diagram. Test lamp must light across the following:

1. TB4 and TB5 - no light - check power source.
2. TB5 and 3 - no light - make sure control contacts are closed.
3. M and 3 - no light - relay circuit open; replace relay.
4. M and 1 - overload protector may be tripped off - wait ten minutes, if no light then protector is defective; replace protector.

Remove wires from L and 3. Insert test lamp in series with TB5 and 3. Touch L2 to the following points momentarily in sequences listed:

S. No light - open winding - replace compressor.

R. No light - open winding - replace compressor.

P. No light - lead P-S defective (or if capacitor used)- open capacitor circuit.

M. No light - lead M-R defective.

L. No light - defective relay.

Remove lead M-R. Test lamp in series with L1 and 3. If light shows when L2 is touched to L, relay is defective; replace with new relay.

If all tests prove satisfactory and there is no capillary restriction and unit still fails to operate properly, change relay.

The wiring between all electrical components and compressor is accomplished with SO 16 two-conductor cable. All wires terminate in the junction box located in the compressor compartment.

If motor cycles on thermal overload, check the following:

1. Dirty condenser - restricted air flow over unit or low voltage.
2. Capillary tube restricted or frozen.
3. Defective starting relay or defective compressor.

SECTION 3 - LOCATING TROUBLES

Methods of testing used to locate the sources of trouble are based on the operating principles of the mechanism. By checking the pressures, the temperatures, the running time, etc., the serviceman is soon able to isolate or pick out that part of the system which is giving trouble.

It is obvious that one must locate the trouble in a refrigeration system before dismantling it in order to keep the service time down to a minimum and to make sure the repair work is going to enable proper functioning of the mechanism after assembly.

The serviceman should check the following items in the refrigeration machinery before coming to a conclusion as to the trouble:

1. Low side pressure.
2. High side pressure.
3. Temperature of cooling unit.
4. Temperature of liquid and suction lines.
5. Amount of dryness of refrigerant.
6. Running time of mechanism.
7. Probability of leaks.
8. Noise.

There are several basic fundamentals that help make locating trouble easier. When there is poor refrigeration or no refrigeration, either one or both of two things can be wrong.

1. There is no refrigerant or very little refrigerant.
2. The pump is not moving the refrigerant (the pressures are (not correct).

If there is no refrigerant, there will be no liquid refrigerant in the evaporating unit. A lack of refrigerant means that the refrigerant has leaked out or it is being held in a certain part of the system by clogged needles, clogged screens, pinched lines, etc. This clogging condition will cause a high vacuum reading on the low side. If there is a lack of refrigerant in the complete system, there will be a hissing sound at the refrigerant control which will indicate the refrigerant passages are not closed. A hissing sound at the refrigerant control always indicates a lack of refrigerant because the dry gas going through the restriction will cause the gas noise.

If the pump is not functioning, the low side pressure will be above normal and the condenser and discharge line from the compressor will be below normal temperature.

To determine what is responsible for a poor condensing condition, proceed as follows:

Install the gage manifold and determine the head pressure. Compare this pressure with what the pressure should be for the refrigerant being used.

If liquid line is partially or completely clogged, if there is moisture frozen in the tube or if the screen is clogged, no refrigerant can pass into the evaporator coil. This stoppage of flow will give a high vacuum reading and a normal or high head pressure. If it is a lack of refrigerant, the low and high side pressures will be below normal.

For a complete Trouble Shooting Chart, see pages 4-10 and 4-11.

TROUBLE SHOOTING CHART

Symptoms	*Cause*	*Remedy*
A. Compressor does not run.	1. Motor line open.	1. Close start or disconnect switch
	2. Fuse blown.	2. Replace fuse.
	3. Tripped overload.	3. See electrical section.
	4. Control stuck open.	4. Repair or replace.
	5. Piston stuck.	5. Remove motor-compressor head. Look for broken valve and jammed parts.
	6. Frozen compressor or motor bearings.	6. Repair or replace.
	7. Control off account cold location.	7. Use thermostatic control or move control to warmer location.
B. Unit short cycles.	1. Control differential set too closely.	1. Widen differential.
	2. Discharge valve leaking.	2. Correct condition.
	3. Motor-compressor overload cutting out.	3. Check for high head pressure, tight bearings, stuck pistons, or clogged condenser.
	4. Shortage of gas.	4. Repair leak and recharge.
	5. Leaky expansion valve.	5. Replace.
	6. Refrigerant overcharge.	6. Purge.
	7. Cycling on high pressure cut-out.	7. Check water supply.
C. Compressor will not start—hums intermittently (cycling on overload).	1. Improperly wired.	1. Check wiring against diagram.
	2. Low line voltage.	2. Check main line voltage — determine location of voltage drop.
	3. Open starting capacitor.	3. Replace starting capacitor.
	4. Relay contacts not closing.	4. Check by operating manually. Replace relay if defective.
	5. Open circuit in starting winding.	5. Check stator leads. If leads, okay replace stator.
	6. Stator winding grounded.	6. Check stator leads. If leads okay, replace stator.
	7. High discharge pressure.	7. Eliminate cause of excessive pressure. Make sure discharge shut-off valve is open.
	8. Tight compressor.	8. Check oil level — correct binding.
D. Compressor starts, motor will not get off starting winding.	1. Low line voltage.	1. Bring up voltage.
	2. Improperly wired.	2. Check wiring against diagram.
	3. Defective relay.	3. Check operation manually — replace relay if defective.
	4. Running capacitor shorted.	4. Check by disconnecting running capacitor.
	5. Starting and running windings shorted.	5. Check resistances. Replace stator if defective.
	6. Starting capacitor weak.	6. Check capacitance, replace if low.
	7. High discharge pressure.	7. Check discharge shut-off valve. Check pressure.
	8. Tight compressor.	8. Check oil level. Check binding.

TROUBLE SHOOTING CHART

Symptoms	*Cause*	*Remedy*
E. Relay burn out.	1. Low line voltage.	1. Increase voltage to not less than 10% under compressor motor rating.
	2. Excessive line voltage.	2. Reduce voltage to maximum of 10% over motor rating.
	3. Incorrect running capacitor.	3. Replace running capacitor with correct mfd. capacitance.
	4. Short cycling.	4. Reduce number starts per hour.
	5. Incorrect mounting.	5. Mount relay in correct position.
	6. Relay vibrating.	6. Mount relay in rigid location.
	7. Incorrect relay.	7. Use relay properly selected for motor characteristics.
F. Starting capacitors burn out.	1. Short cycling.	1. Replace starting capacitor with series arrangement or reduce number of starts per hour to 20 or less.
	2. Prolonged operation on starting winding.	2. Reduce starting load (install suction regulating valve), increase voltage if low.
	3. Relay contacts sticking.	3. Clean contacts or replace relay.
	4. Improper capacitor.	4. Check Parts Catalog for proper capacitor rating — mfd. and voltage.
G. Running capacitors burn out.	1. Excessive line voltage.	1. Reduce line voltage to not over 10% over rating of motor.
	2. High line voltage and light load.	2. Reduce voltage if over 10% excessive. Check voltage imposed on capacitor and select one equivalent to this in voltage rating.
H. Unit operates long or continuously.	1. Shortage of gas.	1. Repair leak and recharge.
	2. Control contacts frozen.	2. Clean points or replace control.
	3. Dirty condenser.	3. Clean condenser.
	4. Location too warm.	4. Change to cooler location.
	5. Air in system.	5. Purge.
	6. Compressor inefficient.	6. Check valves and pistons.
	7. Plugged expansion valve or retainer.	7. Clean or replace.
	8. Iced or plugged coil.	8. Defrost or clean.
	9. Defective insulation.	9. Correct or replace.
	10. Service load.	10. Keep doors closed.
	11. Unit too small.	11. Add unit or replace.
I. Fixture temperature too high.	1. Refrigerant shortage.	1. Repair leak and recharge.
	2. Control set too high.	2. Reset control.
	3. Expansion valve or strainer plugged.	3. Clean or replace.
	4. Compressor inefficient.	4. Check valves and pistons.
	5. Expansion valve set too high.	5. Lower setting.
	6. Iced or dirty coil.	6. Defrost or clean.
	7. Cooling coils too small.	7. Add surface or replace.
	8. Unit too small.	8. Add unit or replace.
	9. Expansion valve too small.	9. Raise suction pressure with larger valve.
	10. Restricted or small gas lines.	10. Clear restriction or increase line size.

WARNING

DISCONNECT POWER FROM UNIT BEFORE DOING ANY MAINTENANCE WORK ON THE ELECTRICAL SYSTEM. THE VOLTAGE USED CAN BE DANGEROUS TO LIFE.

4-14 START CAPACITOR REPLACEMENT

The start capacitor is a non-repairable item, and if it has been determined the capacitor is not functioning properly, it must be replaced.

The following procedure is recommended:

1. Disconnect power.
2. Remove capacitor from retainer on compressor shell, tag and disconnect electrical leads.
3. To install new start capacitor, follow the above procedure in reverse.

4-15 CONDENSER FAN MOTOR REPLACEMENT

If the condenser fan motor is not operating properly it must be replaced.

The following procedure is recommended:

1. Disconnect power.
2. Tag and disconnect electrical leads from condenser fan motor.
3. Remove four hex head screws holding fan motor mounting bracket to mounting base.
4. Carefully remove condenser fan motor from machinery compartment.
5. Remove 4 screws holding condenser fan motor to bracket and pull fan blade from motor shaft.
6. To install new condenser fan motor, follow the above procedure in reverse.

4-16 CONDENSER FAN BLADE REPLACEMENT

Repair to condenser fan blade is limited to straightening of bent or damaged blades.

To replace condenser fan blade follow the procedures for removal of condenser fan motor and install new fan blade.

4-17 MOTOR COMPRESSOR

1. Disconnect motor compressor from power circuit and from control.
2. Purge entire refrigerant charge.
3. Remove burned out motor compressor and mount replacement. DO NOT connect suction and discharge line.
4. Attach refrigerant drum to suction line; purge low side system.
5. Install new filter-drier. Connect liquid and suction lines. Pull deep vacuum on entire system.
6. Re-connect motor-compressor to power circuit and control. Recharge system and thoroughly test for leaks.

4-18 CONTROLS

1. Disconnect refrigerator from power circuit.
2. Remove control cover. Remove leads from terminals. (Note position of wires for replacing on proper terminals.)
3. Disconnect feeler bulb and remove capillary tube from inside refrigerator.
4. Remove bolts holding control to base frame. Remove control and install new control following above procedure in reverse.

4-19 GASKET (DOOR)

1. Remove screws holding gasket to door back clad. Remove old gasket.
2. Place new gasket in position and secure same with screws.

4-20 HARDWARE

Door Latch Handle

1. Edgemont latch handle. Remove screws from side of latch-handle and install replacement

HINGES

1. Open door. Snap hinge cover loose from inside edge of hinge with screwdriver.
2. Close door. Remove screws holding hinge to door and cabinet. Position new hinge and replace screws.

4-21 DEHYDRATOR

1. Close liquid service valve. Run compressor and pump refrigerant into receiver tank until 0 lbs. pressure reading is obtained on back pressure gauge. Close suction service valve.
2. Remove dehydrator from liquid line. Install new dehydrator. Charge system. Check for leaks.

4-22 VALVES

1. Close liquid service valve. Run compressor and pump refrigerant into receiver tank until 0 lbs. Pressure reading is obtained on back pressure gauge. Close suction service valve.
2. Disconnect valve feeler bulb from clamp on suction line.
3. Disconnect flare fittings at inlet and outlet of valve. Remove valve.
4. Install new valve. Reconnect flare fittings, feeler bulb to suction line. Recharge system. Check for leaks.

4-23 CHARGING REFRIGERATION SYSTEM

1. Attach gauge manifold lines to liquid and suction service valve ports and open service valves.
2. Purge system. Pull a vacuum on the system through the gauge manifold to at least 25" vacuum.
3. Correct charge of refrigerant is noted on the nameplate. Add the correct amount and type of refrigerant.
4. Close service valves and remove gauge manifold.

4-24 PRESSURE GAUGE READINGS

Normal operating pressure range at 75°F. ambient for R-12.

Refrigerator
Head Pressure - 120-130 lbs.
Back Pressure - 24- 44 lbs.

QT

8
4
1
2
1
1
1
1
1
1
2
1
1

CHAPTER 5

TABLE 5-1 COMPONENTS PARTS LIST

QTY.	DESCRIPTION	MANUFACTURER	MFR. PART NO.	MGR PART NO.
8	NYLON ROLLER	STD. KEIL	1318-1210-3000	M600444
4	BREAKER STRIP	STD. KEIL	2754-1012-3000	M600260
1	DOOR GASKET	JARROW	9301	M600252
2	DOOR HINGE	STD. KEIL	2842-1009-1110	M600280
1	DOOR LATCH	KASON	172	M600445
1	BOTTLE	MGR	M600443	M600443
1	CONDENSING UNIT	TECUMSEH	AE9417EG	M400350
1	EVAPORATOR BLOWER	PEERLESS	MJ-40	M300137
1	CAPILLARY TUBE	MGR	M300230	M300230
1	DEHYDRATOR	ALCO	EK-032	M300116
2	TEMPERATURE CONTROL	RANCO	A30-542	M300121
1	CONDENSATE EVAP.	STD. KEIL	2712-0011-1000	M400183
1	TERMINAL BLOCK	KULKA	601-	M400018
2	JUNCTION BOX	PERFECT LINE	LT11-33	M400100
1	TRANSFORMER	GRAINGER	3A369	M400358
1	PLUG 115V., 15A.	GRAINGER	1A175	M400357
1	PLUG 220V., 20A	GRAINGER	3A380	M400360
1	RECEPTICAL 115V.	GRAINGER	5Z821	M400361
1	TEMP. MONITOR	KASON	KTA-III	M400359
1	TEMP. RECORDER	WEKSLER	08G1-C3B	M300231

TABLE 5-2 MAINTENANCE PARTS LIST

QTY.	DESCRIPTION	MANUFACTURER	MFR. PART NO.	MGR PART NO.
1	RELAY, COMPRESSOR	TECUMSEH	82628	M400353
1	OVERLOAD, THERMAL	TECUMSEH	8300MRPD19	M400352
1	CAPACITOR, START	TECUMSEH	85635-2	M400354
1	COND. FAN MOTOR	TECUMSEH	810M004A02	M400355
1	COND. FAN BLADE	TECUMSEH	51536	M400356
1	DOOR GASKET	JARROW	9301	M600252
1	DOOR HINGE	STD. KEIL	2842-1009-1110	M600280
1	DOOR LATCH	KASON	172	M600445
1	CAPILLARY TUBE	MGR	M300230	M300230
1	DEHYDRATOR	ALCO	EK-032	M300116
1	TEMPERATURE CONTROL	RANCO	A30-542	M300121
1	NYLON ROLLER	STD. KEIL	1318-1210-3000	M600444

TABLE 5-3 LIST OF MANUFACTURERS

CAGE NO.	MANUFACTURER	PART NO.
70255	Alco Controls P.O. Box 12700 St. Louis, MO 63141	EK-032
25795	Grainger W. W. Inc. 5959 W. Howard St. Chicago, IL 60648	1A175, 3A369, 3A380, 5Z821
74951	Jarrow Products 2000 N. Southport Ave. Chicago, IL 60614	9301
32761	Kason Hardware Corp. Colesville Rd. Binghamton, NY 13902	KTA-III, 172
75382	Kulka Electric Corp. 520 S. Fulton Ave. Mt. Vernon, NY 10551	601-6
11718	MGR Equipment Corp. 22 Gates Ave. Inwood, NY 11696	M300230, M600443
46150	Peerless of America Inc. 5800 N. Pulaski Rd. Chicago, IL 60646	MJ-40
17245	Perfect Line Mfg. Co. 80 E. Gates Ave. Lindenhurst, NY 11757	LT11-33
49742	Ranco Inc. 555 Metro Place N. Dublin, OH 43017	A30-542
87518	Standard Keil Rt. 34 & Garden St. Pkwy. Allenwood, NJ 08720	1318-1210-3000, 2754-1012-3000 2842-1009-1000, 2712-0011-1000
59431	Tecumseh Products 959 Brown St. Tecumseh, MI 49286	AE9417EG, 82628, 8300MRPD19 85635-2, 810M004A02, 51536